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1. Your reference

A. CASATI 1-1-1

2. Patent application number
(The Patent Office will fill in this part)

9913334.0 -8 JUN 1999

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

LUCENT TECHNOLOGIES INC
600 Mountain Avenue
Murray Hill,
New Jersey 07974-0636
United States of America

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

Delaware USA 7039555001

4. Title of the invention

IMPROVED MOBILE IP DEPLOYMENT

5. Name of your agent *(if you have one)*

D.J. WILLIAMS
Lucent Technologies UK Limited
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Essex IG8 0TU
England

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Patents ADP number *(if you know it)*

7675465001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

Patents Form 1/77

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Continuation sheets of this form	
Description	10
Claim(s)	1
Abstract	-
Drawing(s)	-

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Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	1
Request for preliminary examination and search *(Patents Form 9/77)*	-
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature

Date 8th June 1999

12. Name and daytime telephone number of person to contact in the United Kingdom

D.J. WILLIAMS 0181-504 2824

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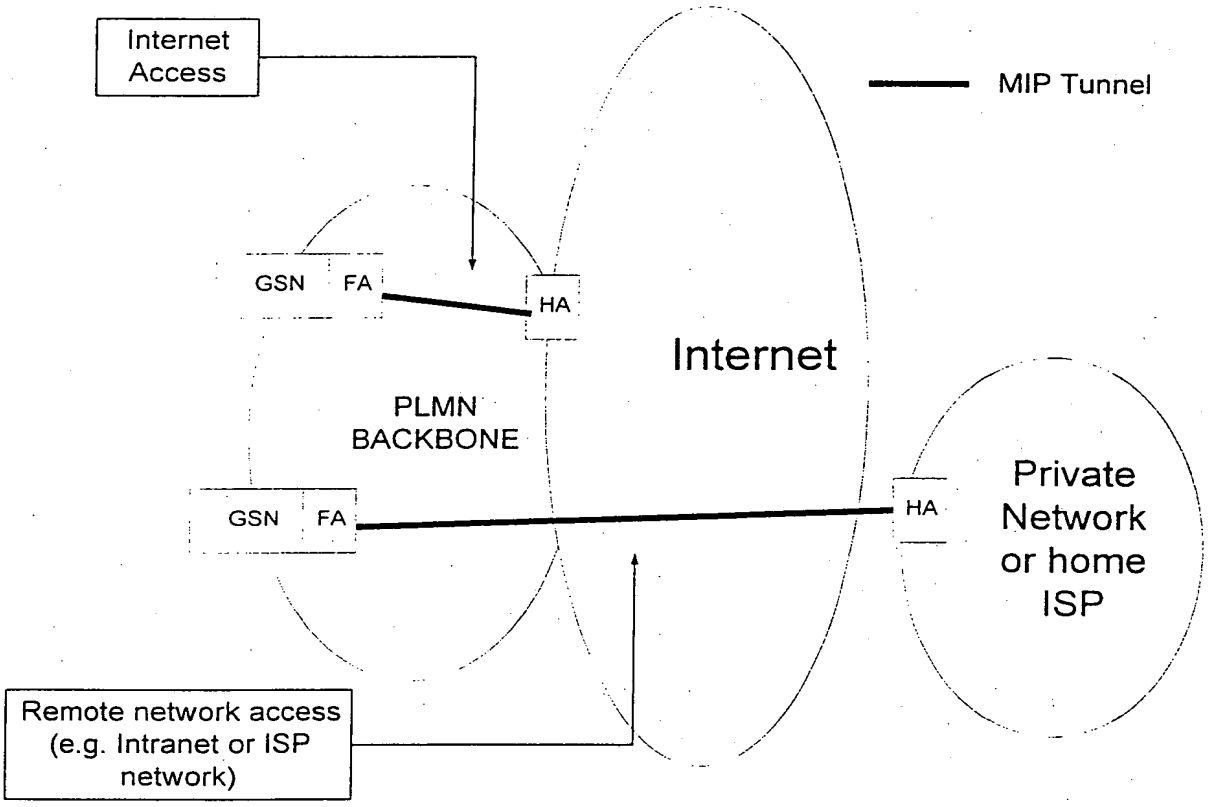
IMPROVED MOBILE IP DEPLOYMENT

The present invention relates to an advanced scenario for MIP deployment in UMTS/GPRS. It is discussed in the context of advanced deployment scenarios of MIP and how they fit in an evolutionary scenario starting from a GPRS system deployment assumption. The disclosure is presented as a way to deploy mobile IP also to handle intra-system mobility.

SUPPORT OF MOBILE IP: AN ADVANCED SCENARIO



In the picture above an advanced deployment scenario is depicted. In this case the IGSN performs a subset of the functionality performed by the combined SGSN and GGSN for mobile IP purposes.

The goal to achieve is not to change 04.08 and to minimize the changes in GPRS standards.

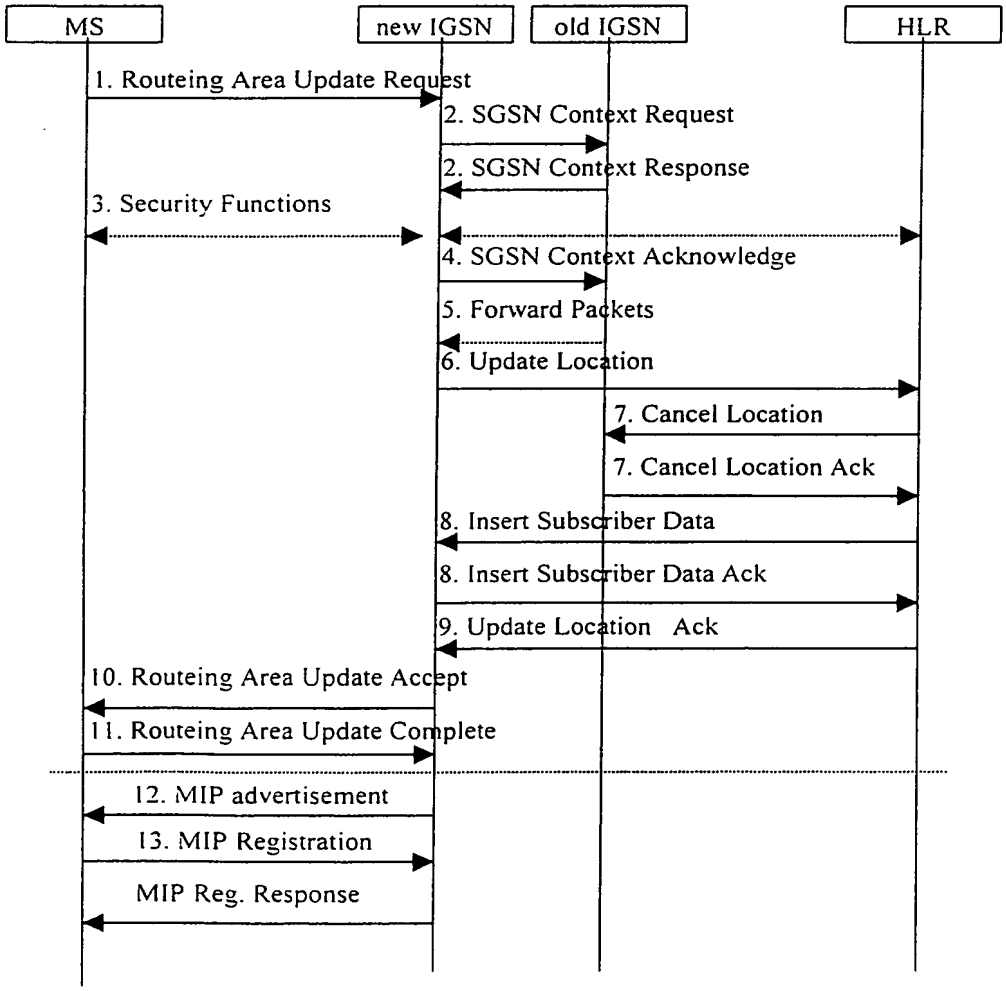
The session activation and initial registration is completely identical to the case in which the FA is placed at a GGSN [see Tdoc s2m99036]. It is assumed that every IGSN is equipped with a FA. The IGSN may be an SGSN that behaves in a different way when the APN specified in the PDP context activation request or in the subscription data selects Mobile IP mode of operation. Instead of sending a PDP context Activation request to a GGSN, the IGSN sends a PDP context Creation Response to the

mobile terminal and triggers a FA to send the advertisement to the Mobile station that is requesting the activation of a session, in the same way as it is done when the FA is at the GGSN.

The difference with respect to the case where the FA is at a GGSN non colocated with the SGSN is in that inter-IGSN mobility is handled by mobile IP, with the optional support of existing SGSN [redacted] ic functionality in order to transfer packets from one IGSN to another when handover occurs.
In the sequel, RA update procedures are described. The approach chosen is to highlight the differences with respect to current specs (in particular with what is written in GSM TS 03.60, from which the text is drawn).

INTER IGSN ROUTING AREA UPDATE

Note: throughout this section, wherever the word 'SGSN' is met, it must be considered as a SGSN functionality. We do not imply or suggest the IGSN to be only an SGSN. The transfer of packets from the old IGSN to the new IGSN may be deemed not necessary, or not required because of Mobile IP standard evolution.



1) The MS sends a Routeing Area Update Request (old RAI, old P-TMSI Signature, Update Type) to the new SGSN. Update Type shall indicate RA update or periodic RA update. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell form where the message was received before passing the message to the SGSN.

2) The new SGSN sends SGSN Context Request (old RAI, TLLI, old P-TMSI Signature, New SGSN Address) to the old SGSN to get the MM and PDP contexts for the MS. The old SGSN validates the old P-TMSI Signature and responds with an appropriate error cause if it does not match the value stored in the old SGSN. This should initiate the security functions in the new SGSN. If the security functions authenticate the MS correctly, the new SGSN shall send an SGSN Context Request (old RAI, TLLI, MS Validated, New SGSN Address) message to the old SGSN. MS Validated indicates that the new SGSN has authenticated the MS. If the old P-TMSI Signature was valid or if the new SGSN indicates that it has authenticated the MS, the old SGSN responds with SGSN Context Response (MM Context, PDP Contexts, LLC Ack). If the MS is not known in the old SGSN, the old SGSN responds with an appropriate error cause. The old SGSN stores New SGSN Address, to allow the old SGSN to forward data packets to the new SGSN. LLC Ack contains the acknowledgements for each LLC connection used by the MS. Each PDP Context includes the GTP sequence number for the next downlink N-PDU to be sent to the MS and the GTP sequence number for the next uplink N-PDU to be tunnelled *via mobile IP tunnel* to the *HA*. The old SGSN starts a timer and stops the transmission of N-PDUs to the MS.

3) Security functions may be executed. These procedures are defined in subclause "Security Function". Ciphering mode shall be set if ciphering is supported.

4) The new SGSN sends an SGSN Context Acknowledge message to the old SGSN. This informs the old SGSN that the new SGSN is ready to receive data packets belonging to the activated PDP contexts. The old SGSN marks in its context that the MSC/VLR association and the information in the HLR are invalid. This triggers the MSC/VLR and the HLR to be updated if the MS initiates a routeing area update procedure back to the old SGSN before completing the ongoing routeing area update procedure. If the security functions do not authenticate the MS correctly, then the routing area update shall be rejected, and the new SGSN shall send a reject indication to the old SGSN. The old SGSN shall continue as if the SGSN Context Request was never received.

5)The old SGSN duplicates the buffered N-PDUs and starts tunnelling them to the new SGSN. Additional N-PDUs received before the timer described in step 2 expires are also duplicated and tunnelled to the new SGSN. N-PDUs that were already sent to the MS and that are not yet acknowledged by the MS are tunnelled together with the number of the LLC frame that transferred the last segment of the N-PDU. No N-PDUs shall be forwarded to the new SGSN after expiry of the timer described in step 2.

6) The new SGSN informs the HLR of the change of SGSN by sending Update Location (SGSN Number, SGSN Address, IMSI) to the HLR.

7) The HLR sends Cancel Location (IMSI, Cancellation Type) to the old SGSN with Cancellation Type set to Update Procedure. If the timer described in step 2 is not running, then the old SGSN removes the MM and PDP contexts. Otherwise, the contexts are removed only when the timer expires. This allows the old SGSN to complete the forwarding of N-PDUs. It also ensures that the MM and PDP contexts are kept in the old SGSN in case the MS initiates another inter SGSN routeing area update before completing the ongoing routeing area update to the new SGSN. The old SGSN acknowledges with Cancel Location Ack (IMSI).

8) The HLR sends Insert Subscriber Data (IMSI, GPRS subscription data) to the new SGSN. The new SGSN validates the MS's presence in the (new) RA. If due to regional subscription the MS is rejected, the SGSN rejects the Routeing Area Update Request with an appropriate cause and returns an Insert Subscriber Data Ack (IMSI, SGSN Area Restricted Due To Regional Subscription) message to the HLR. If all checks are successful then the SGSN constructs an MM context for the MS and returns an Insert Subscriber Data Ack (IMSI) message to the HLR.

9) The HLR acknowledges the Update Location by sending Update Location Ack (IMSI) to the new SGSN.

10) The new SGSN validates the MS's presence in the new RA. If due to regional, national or international restrictions the MS is not allowed to attach in the RA or subscription checking fails, then the new SGSN rejects the routeing area update with an appropriate cause. If all checks are successful then the new SGSN constructs MM and PDP contexts for the MS. A logical link is established between the new SGSN and the MS. The new SGSN responds to the MS with Routeing Area Update Accept (P-TMSI, LLC Ack, P-TMSI Signature). LLC Ack contains the acknowledgements for each LLC connection used by the MS. thereby confirming all mobile-originated N-PDUs successfully transferred before the start of the update procedure.

11) The MS acknowledges the new P-TMSI with a Routeing Area Update Complete (P-TMSI, LLC Ack). LLC Ack contains the acknowledgements for each LLC connection used by the MS, thereby confirming all mobile-terminated N-PDUs successfully transferred before the start of the update procedure. If LLC Ack confirms reception of N-PDUs that were forwarded from the old SGSN, then these N-PDUs shall be discarded by the new SGSN. LLC and SNDCP in the MS are reset locally.

12) Over the newly setup link to the mobile, a Mobile IPAgent Advertisement is sent including challenge/response and NAI extensions This is triggered in some way not specified here and implementation dependent.

It is sent only to the mobile performing the RA update. This is sent in such a way that subnet prefix based movement detection algorithm the Mobile IP spec [RFC2002] suggests triggers an immediate mobile IP registration (i.e. by making sure no two FA in the PLMN send advertisements with identical subnet prefixes).

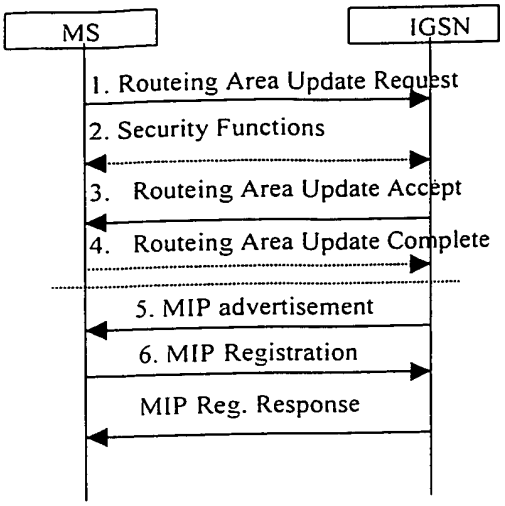
13) The normal MIP registration is performed. This will be periodically repeated according to timers negotiated in the registration, in order to keep the MIP session alive.

In the case of a rejected routeing area update operation, due to Routeing Area restrictions, the new SGSN shall not construct an MM context. A reject shall be returned to the MS with an appropriate cause. The MS shall not re-attempt a routeing area update to that RA. The RAI value shall be deleted when the MS is powered-up.

If the timer described in step 2 expires and no Cancel Location (IMSI) was received from the HLR, then the old SGSN shall stop forwarding N-PDUs to the new SGSN.

If the routeing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routeing Area Update Reject (Cause) message, the MS shall enter IDLE state.

INTRA IGSN RA UPDATE



1) The MS sends a Routeing Area Update Request (old RAI, old P-TMSI Signature, Update Type) to the SGSN. Update Type shall indicate RA update. The BSS shall add the Cell Global Identity including the RAC and LAC of the cell where the message was received before passing the message to the SGSN, see GSM 08.18.

2) Security functions may be executed. These procedures are defined in subclause "Security Function".

3) The SGSN validates the MS's presence in the new RA. If due to regional, national or international restrictions the MS is not allowed to attach in the RA or subscription checking fails, then the SGSN rejects the routeing area update with an appropriate cause. If all checks are successful then the SGSN updates the MM context for the MS. A new P-TMSI may be allocated. A Routeing Area Update Accept (P-TMSI, P-TMSI Signature) is returned to the MS.

4) If P-TMSI was reallocated, the MS acknowledges the new P-TMSI with Routeing Area Update Complete (P-TMSI).

5) If the New routing area is under the domain of a new FA (e.g. for load sharing reasons) then a Mobile IPAgent Advertisement is sent including challenge/response and NAI extensions This is triggered in some way not specified here and implementation dependent. It is sent only to the mobile performing the RA update. This is sent in such a way that subnet prefix based movement detection algorithm the Mobile IP spec [RFC2002] suggests trigger an immediate mobile IP registration (i.e. by making sure no two FA in the PLMN send advertisements with identical subnet prefixes).

6) The regular MIP registration is performed. This will be periodically repeated according to timers negotiated in the registration, in order to keep the MIP session alive.

If the routeing area update procedure fails a maximum allowable number of times, or if the SGSN returns a Routeing Area Update Reject (Cause) message, the MS shall enter IDLE state.

MOBILE IP SPECIFIC DETAILS

The lifetime of the MIP registration should be set to a value >> periodic RA updates interval (Timer T3312), so that the necessity to send MIP Registration does not arise more frequently than Periodic RA updates.

The lifetime of a MIP advertisement should be set to a value > > T3312 as well, so that attempts to register are not more frequent than Periodic RA updates (a short Advertisement lifetime may require sending many advertisements over the air, or, missing this, it may trigger the mobile to re-register frequently, since the lifetime based movement detection algorithm may be triggered) .

Periodic RA updates should not trigger MIP registrations.

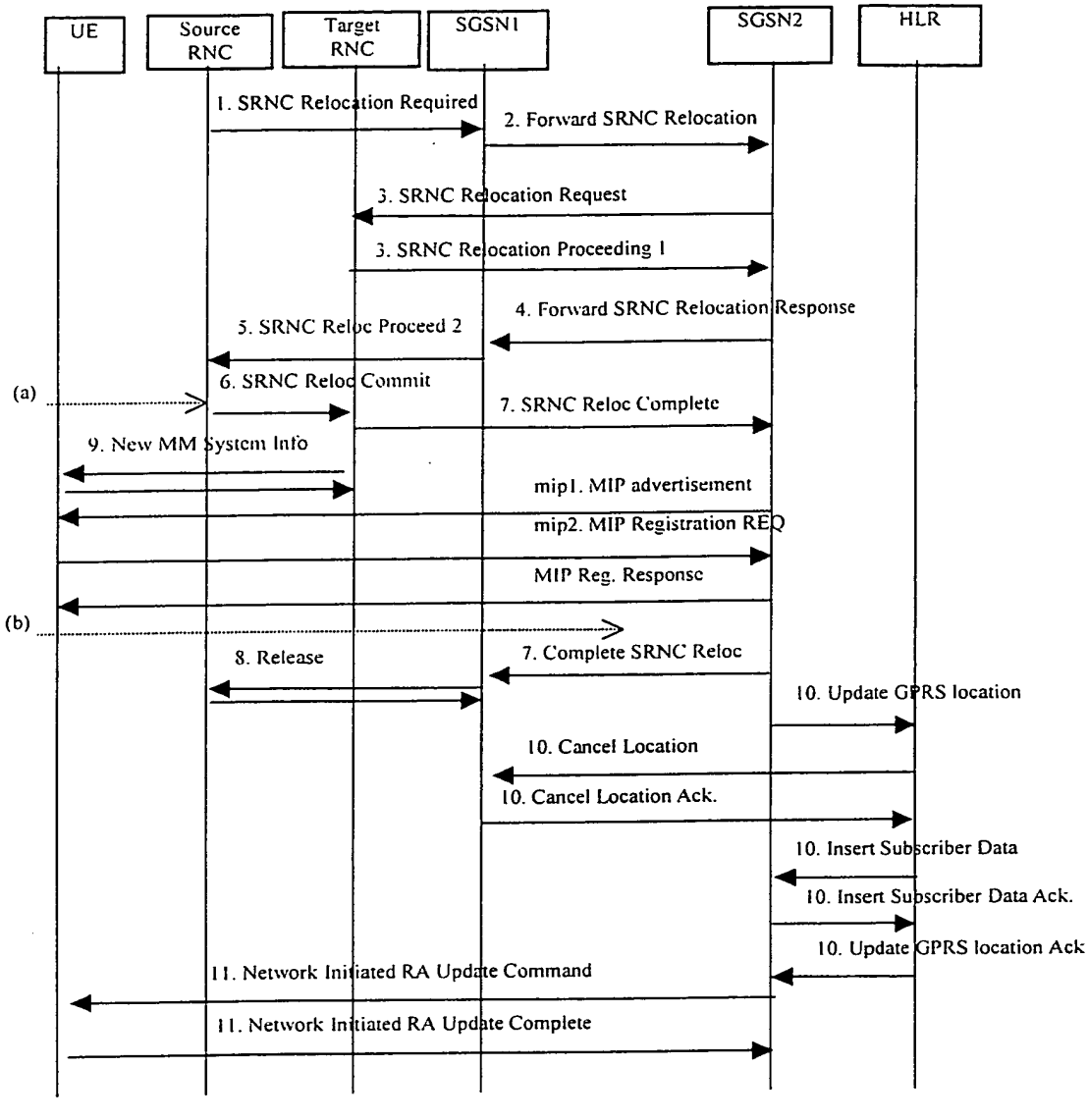
The UMTS case

This part of the contribution addresses what could be done in UMTS when an SRNS relocation would happen. This does not provide low level details, and basically it's a modification of what is written in 23.20.

When the mobile is in idle mode, the procedures defined for GPRS works the same way in UMTS.

When the mobile is in connected state, the following SRNS relocation procedure takes place.

When the word "SGSN" is used, it is used to indicate a functionality and not a physical node.



1) UTRAN makes the decision to perform the Serving RNC relocation procedure. This includes decision on into which RNC (Target RNC) the Serving RNC functionality is to be relocated. The source SRNC sends SRNC Relocation required messages to the SGSN1. This message includes parameters such as target RNC identifier and an information field that shall be passed transparently to the target RNC.

2) Upon reception of SRNC Relocation required message the SGSN1 determines from the received information that the SRNC relocation will (in this case) result in change of SGSN. The SGSN will then send a Forward SRNC relocation request to the applicable SGSN, SGSN2, including the information received from the Source RNC and necessary information for the change of SGSN (e.g. MM context, PDP context).

3) The SGSN2 will send a SRNC Relocation Request message to the target RNC. This message includes information for building up the SRNC context, transparently sent from Source RNC (e.g. UE id., no of connected CN nodes, UE capability information), and directives for setting up Iu user plane transport bearers.
When the Iu user plane transport bearers have been established, and target RNC completed its preparation phase, SRNC Relocation Proceeding 1 message is sent to the SGSN2.

4) When the traffic resources between target RNC and SGSN2 has been allocated and the SGSN2 is ready for the SRNC move, then the Forward SRNC Relocation Response is sent from SGSN2 to SGSN1. This message indicates that necessary resources have been allocated for the SRNC relocation.

5) When the Forward SRNC Relocation Response has been received in the SGSN1, the SGSN1 indicates the completion of preparation phase at the CN side for the SRNC relocation by sending the SRNC Relocation Proceeding 2 message to the Source RNC.

6) When the source RNC has received the SRNC Relocation Proceeding 2 message, the source RNC sends a SRNC Relocation Commit message to the target RNC. The target RNC executes switch for all bearers at the earliest suitable time instance.

7) Immediately after a successful switch at RNC, target RNC (=SRNC) sends SRNC Relocation Complete message to the SGSN2. The SGSN will also send a Complete SRNC Relocation towards the SGSN1.

8) At reception of the Complete SRNC Relocation, SGSN1 will send a release indication towards the Source RNC. This will imply release of all UTRAN resources that were related to this UE.

Mip 1) Over the newly setup link to the mobile (the target RNS is now acting as SRNS) a Mobile IP Agent Advertisement is sent including challenge/response and NAI extensions. This is triggered in some way not specified here and implementation dependent.
It is sent only to the mobile performing the SRNS relocation. This is sent in such a way that subnet prefix based movement detection algorithm the Mobile IP spec [RFC2002] suggests triggers an immediate mobile IP registration (i.e. by making sure no two FA in the PLMN send advertisements with identical subnet prefixes).

When the target RNC is acting as Mip 2) The normal MIP registration is performed. This will be periodically repeated according to timers negotiated in the registration, in order to keep the MIP session alive.

9) SRNC, it will send New MM System Information to the UE indicating e.g. relevant [redacted]ng Area and Location Area. Additional RRC information may then also be sent to the [redacted]e.g. new RNTI identity.

10) The SGSN2 informs the HLR of the change of SGSN by sending Update GPRS location (IMSI, new SGSN address etc.) to the HLR. The HLR cancels the context in the old SGSN, SGSN1, by sending Cancel Location (IMSI). The SGSN1 removes the context and acknowledges with Cancel Location Ack. The HLR sends Insert subscriber data (IMS[redacted] subscription data) to the SGSN2. The SGSN2 acknowledges with Insert Subscriber Data Ack. The HLR acknowledges the Update GPRS location by sending Update GPRS Location Ack to the SGSN2.

11) At reception of Insert subscriber data from HLR, the SGSN2 will initiate the update of MM information stored in the UE. This is done by sending Network Initiated Routing Area Update Command to the UE. This message will include new RAI, and possible also new P-TMSI. When the UE has made necessary updates it answers with Network Initiated Routing Area Update Complete.

Before point (a), in Figure 19, the connection is established between UE and *HA* via Source RNC and SGSN1.

After point (b), in Figure 19, the connection is established between UE and *HA* via Target RNC and SGSN2.

Claims

1. A mobile IP environment substantially as described herein with reference to or as shown in any one of the accompanying drawings.
2. A method of operating or controlling a mobile IP environment substantially as described herein with reference to or as shown in any one of the accompanying drawings.